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Theory for electron- and hole-doped cuprate superconductors: D-wave symmetry order parameter

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Abstract

Using as a model the Hubbard Hamiltonian, we determine various basic properties of electron- and hole-doped cuprate superconductors for a spin-fluctuation-induced pairing mechanism. We find for both hole-and electron-doped cuprates dx2-y2 symmetry for the superconducting order parameter. We find a narrow doping range of superconductivity for electron-doped superconductors like Nd2-xCexCuO4 and Pr2-xCexCuO4. The superconducting transition temperatures Tc(x) for various electron doping concentrations x are calculated to be much smaller than for hole-doped cuprates due to the different energy dispersion and a flat band well below the Fermi level for electron-doped superconductors. Lattice disorder may sensitively distort the symmetry dx2-y2 via electron-phonon interaction. We present a general discussion of the symmetry of the order parameter which should apply also to other spin-fluctuation-induced superconductors. Furthermore, we show how our theory may also explain the neutron scattering data.

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